Remarks

Claims 1-6, and 8-43 were pending. Claims 1 and 42 have been amended. Reconsideration and reexamination are respectfully requested in view of the amendments and the following remarks.

The rejection of claim 6 under 35 U.S.C. § 112, second paragraph is respectfully traversed. Claim 6 does further limit the subject matter of claim 1. Claim 6 recites adjusting the moisture content to a predetermined amount. Because claim 1 recites a range of moisture content, claim 6 involves adjusting it to a predetermined amount within that range. Therefore, claim 6 is in compliance with 35 U.S.C. § 112, second paragraph. Applicants respectfully request that this rejection be withdrawn.

The rejection of claims 1-6, and 8-43 under 35 U.S.C. §103(a) as obvious over Riebel in combination with Young is respectfully traversed. Riebel discloses a fiber-reinforced protein-based biocomposite particulate material containing a legume-based thermosetting resin and cellulosic material, and rigid biocomposite pressure-formed materials produced therefrom. Abstract.

According to the examiner, "Riebel et al . . . teaches a process of making a cellulose fiber composite including the steps of mixing a protein hydrolysate (i.e., a legume-based resin) with cellulosic material, mixing this material with a synthetic resin (e.g., isocyanate resin, phenolic resin) (wherein the moisture content of the cellulosic resin is reduced to less than about 20% after application of the resin binder . . . to form a cellulosic material/resin binder blend, forming the blend into a shape and molding or pressing the shape to produce a cellulosic fiber composite. While Riebel et al does not explicitly teach the exact order of mixing the materials as set forth in independent claims 1 and 42, there is no demonstrated criticality in the order of mixing, the open language (e.g., "comprising") of the claims does not limit the order of mixing, and the process of Riebel et al results in the same cellulosic material/resin binder blend as set forth in the instant claims."

However, contrary to the examiner's position, the claims do identify the order of mixing. It is the claimed *resin binder* which is mixed with the cellulosic material. The claim recites "mixing a protein hydrolysate with a synthetic resin, wherein the synthetic resin is phenolic resin, isocyanate resin, or combinations thereof, to produce a resin binder; mixing the resin

binder with a cellulosic material to form a cellulosic material/resin binder blend . . . ." Riebel's legume-based resin is not the claimed resin binder. Riebel does not produce a resin binder as claimed because Riebel does not mix the legume-based resin with a synthetic resin. Instead, Riebel mixes the legume-based resin with the cellulose, and dries the particulate material to a moisture content of less than about 20%. The dry particulate material is then coated with the thermosetting binder. Col. 11 line 64 to col. 12, line 16; and col. 12, lines 56-67.

Riebel specifically teaches away from mixing the thermosetting binder with the legume-based resin before the cellulose is added.

> As discussed in Example 8 below, control of the moisture content of the particles is particularly important when an isocyanate is used. For example, *if MDI is added to the wet particles, through addition to the resin prior to addition of the cellulose, no significant advantage is realized in the mechanical properties of the resultant pressure-formed products*. However, if the MDI is added to the particles that are dried to a moisture content of less than about 20%, preferably less than about 15%, more preferably less than about 12% (often about 3-12%), and most preferably about 6-8%, significant advantage is realized in mechanical properties as well as physical properties.

Col. 12, lines 56-67.

Applicants' process provides a number of advantages over Riebel's process, including using less resin binder than Riebel's process, providing a cellulosic material/resin binder blend which has less moisture than Riebel's process requires, and consequently eliminating the drying step that is required in Riebel's process.

According to the Office Action, "Riebel et al teaches a moisture content of less than 20% (see col. 6, lines 47-64 of Riebel et al; note also that in Example 2 of Riebel et al (referred to by applicant), the moisture content is 11% prior to pressing). Even if Riebel et al use a drying step, or use a longer pressing step, this teaching of Riebel et al meets the claimed limitation of moisture content of the cellulosic material after application of the resin binder [sic]" However, Riebel does not teach or suggest that "the average moisture content of the cellulosic material is between about 8% and about 35% by weight after application of the resin binder and before felting, without drying cellulosic material/resin binder blend" as now claimed. Support for the amendment can be found in Paragraphs [0043, 0045-0046].

Riebel uses particulate material (legume-based resin and cellulosic material) with at least 55% moisture.

> Upon formation, the particulate material preferably contains about 55-75% moisture, i.e., water, and more preferably about 59-67% moisture, based on the total wet weight of the particles. As used herein, this material is referred to as the "high moisture-content" particulate material or particles. These particles are typically in the form of soft, pliable, tacky, irregularly shaped lumps or balls, although individual fiber-like particles can also be formed. They typically have a particle size (as determined by the largest dimension of the particle) of no greater than about 0.5 inch (1.3 cm), and often no greater than about 0.38 inch (0.97 cm). Typically, particles larger than this do not generally process well, e.g., dry or press well. These discrete particles are formed substantially simultaneously from an agglomerated mass of cellulosic material and legume-based resin under appropriate processing conditions, as described below. They have a relatively dry-feeling or semi-dry feeling even though they contain a large amount of water, e.g., about 55-75% total water content, which is believed to be bound within the particles such that it cannot be readily squeezed out under hand pressure as water is from a sponge. These high moisture-content particles have sufficient internal bond strength to exist as discrete particles. Thus, they can be handled relatively easily in bulk manufacturing processes without significantly sticking together and agglomerating into larger particles.
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> Distinct advantages have been obtained upon forming such high moisture-content particles. For example, the unique "granite-like" appearance of the pressure-formed products of the present invention results from the fact that the composition and process described herein forms composite particles of this type. Although particles containing about 55-75% water are capable of forming pressure-formed products, particular advantage is realized if the moisture content is within a range of about 59-67%. That is, when the moisture content of the originally formed particles is about 59-67%, particularly desirable pressure-formed products with respect to their mechanical properties (e.g., high modulus of rupture, high modulus of elasticity, high hardness) and physical properties (e.g., low water absorption), are obtained, as illustrated by Example 2. Although the inventors do not intend to be held to any particular theory, it is believed that this optimum

moisture content provides substantially complete impregnation of the cellulosic material, e.g., paper flakes, by the protein-based resin such that all the fibers are integrally associated or "fused" with the resin. If less than about 59% water is present in the high moisture-content particles, the cellulosic material is not fully impregnated and cellulose fibers protrude from the pliable balls forming "fuzzy" extensions. There may even be pieces of uncoated paper. If greater than about 75% water is used in the preparation of the particles, a slurry generally results from which particles are not formed. Furthermore, at such a high water content, the soy resin is diluted to the extent that the interparticle bond strength is reduced considerably. Thus, these high moisture-content particles are not simply surface-coated pieces of paper, nor are they particles of pulped paper.

Col. 5, line 57 to col. 6, line 47

Upon blending the colored batches at stage 4, a mixture of relatively dry-feeling or semi-dry feeling ball-shaped particles is obtained, although the particles contain a large amount of water, e.g., about 55-75% total water content. Although the consistency of the mixture could be referred to as being similar to coleslaw in that coleslaw contains "wet" particles, the consistency is more like a flocculant, and is significantly different from the aqueous slurries or adhesive-coated paper flakes that are prepared in most conventional recycled newsprint processes.

Col. 17, line 61 to col. 18, line 3.

Riebel teaches away from using particulate material having a moisture content of less than 55%. In Example 2, Riebel described the effect of using particles having moisture contents between 55% and 75%. The panels made with a moisture content of 55% had the poorest strength and stiffness, and had poor swell characteristics.

The panels made with the lowest wet particle moisture content exhibited the poorest strength and stiffness. This is due to the poor coverage of the soy resin on the paper particles. The numerous uncoated paper particles that are present in the final press panel do not provide significant strength or stiffness to the panel. This resulted in the 55% wet particle moisture content panels having poorer mechanical properties when compared to the other moisture contents. As the viscosity of the resin decreased, the

> coverage of the paper particles increased. However, there was no detectable difference in strength or stiffness between the wet particle moisture content ranges of 59% to 75%.

Col. 28, lines 9-23.

> The panels manufactured with the 55% wet moisture content particles exhibited poor two-hour and twenty-four hour edge swell characteristics. This was due to the poor soy resin coverage previously mentioned.

Col. 28, lines 48-51.

In Riebel, the moisture content of the high moisture content particulate material (55-75% moisture) is reduced by drying.

> The discrete fiber-reinforced protein-based particles initially formed have a moisture content of about 55-75% and a particle size no greater than about 0.5 inch (1.3 cm). For particular advantage in the pressure-forming process, the moisture content of these discrete particles is reduced to less than about 20%, preferably to less than about 15%, and more preferably to less than about 12%.

Col. 3, lines 17-23.

> Typically and preferably, prior to fusing into a rigid pressure-formed material, the moisture content of the high moisture-content biocomposite particulate material is reduced to less than about 20%, preferably less than about 15%, more preferably less than about 12%, and most preferably about 3-12%, based on the total weight of the biocomposite particles. If the moisture content is too low, however, the biocomposite particles do not generally bind well upon fusing them together under elevated pressures and temperatures, without the addition of a secondary thermosetting binder. For certain applications, the moisture content is narrowly tailored to about 8-11%, whereas in other applications the moisture content is narrowly tailored to about 6-8%. Generally, the biocomposite particles containing 6-8% moisture are ideal for preferred processes wherein the particles are coated with a secondary thermosetting binder, e.g., an aromatic isocyanate.
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> During the drying process, not only is water removed but the protein-based resin is at least partially cured. In this way, the particulate material has internal bond strength. Furthermore, these particles are capable of being bonded or fused together under heat and

pressure. This is because the viscoelasticity can be altered with elevated temperatures and pressures such that the particles are plasticized and flowable but not meltable, i.e., the thermoset resin/cellulose composite particles are plastically deformable but not sufficiently thermoplastic to melt. It is also believed that the thermoset resin further cures such that there are resin-resin interactions between the particles, although not to such an extent that the particles flow together and lose their distinct boundaries.

Col. 6, line 48 to col. 7, line 10

The legume-based resin and cellulosic material are combined in a manner to form the high moisture-content particulate material described above. Upon drying, the particulate material can be stored for an indefinite period of time before being formed into the pressure-formed products.

Col. 11, line 64 to col. 12, line 1.

However, if the MDI is added to the particles that are dried to a moisture content of less than about 20%, preferably less than about 15%, more preferably less than about 12% (often about 3-12%), and most preferably about 6-8%, significant advantage is realized in mechanical properties as well as physical properties.

Col. 12, lines 62-67.

In general, the pressure-formed products of the present invention are made by a process that involves fusing the dry biocomposite particulate material described above into a rigid thermoset biocomposite material. Preferably, the process involves five separate and distinct stages: (1) obtaining the required raw materials; (2) preparing the legume-based resin, i.e., the biocomposite matrix material; (3) preparing the high moisture-content biocomposite particulate material; (4) reducing the moisture content of the high moisture-content biocomposite particulate material, optionally containing an admixture of separate colorized batches of the particles; and (5) compacting and further curing the dry particulate material, optionally coated with a secondary thermosetting binder. The resulting material, e.g., board stock or shaped object, is suitable for further forming and finishing steps, e.g., structure fabrication, surface finishing, mechanical shaping, etc.

Col. 14, lines 21-37.

> This admixture of differently colored particulate materials is preferably subjected to a drying step, wherein it is partially dried for a sufficient amount of time and at a sufficient temperature to reduce the moisture content to less than about 20%, preferably to less than about 15%, and more preferably to less than about 12%, based on the total weight of the particulate material. While a small quantity of moisture is generally necessary to permit the reaction of the resin with the fibrous cellulose and promote preferential bonding, extraneous water hampers later curing and can increase production costs. Although advantage is achieved by drying the combined colored batches of particulate material, this is not necessarily a requirement. That is, each batch can be partially dried prior to mixing them together.

Col. 18, lines 4-17.

> Alternatively, drying can be achieved by compressing or preforming the particles in the presence of heat, although this is not preferred because of the danger of causing blow-outs as discussed above. Final water removal may occur at the "hot press" step or stage 5 of FIG. 3 (or in the second roller compression step of stage 5 in the continuous extrusion process of FIG. 4).

Col. 19, lines 10-16.

Thus, Riebel forms a high moisture content particulate material (55-75%) by mixing the legume-based resin and the cellulosic material, and reduces the moisture content of the high moisture content particulate material by drying (less than 20%).

However, in the claimed invention, "the average moisture content of the cellulosic material is between about 8% and about 35% by weight after application of the resin binder and before felting, without drying cellulosic material/resin binder blend." No additional drying step prior to pressing is needed using cellulosic material/resin binder blend having the claimed average moisture content. Paragraphs [0005, 0032, 0043, and 0045-0046]. Thus, the present invention provides a process with fewer steps, and/or lower cost compared to Riebel.

Young is cited as teaching the step of felting. Young does not remedy the deficiencies of Riebel.

Therefore, claims 1-6, and 8-43 would not have been obvious to one having ordinary skill in the art at the time the invention was made over Riebel in combination with Young.

Conclusion

Applicants respectfully submit that, in view of the above remarks, the application is in condition for allowance. The Examiner is encouraged to contact the undersigned to resolve efficiently any formal matters or to discuss any aspects of the application or of this response. Otherwise, early notification of allowable subject matter is respectfully solicited.

Respectfully submitted,
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